

HOW PROJECT MANAGERS REALLY MANAGE: AN INDEPTH LOOK AT SOME MANAGERS OF LARGE, COMPLEX NASA PROJECTS

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ABSTRACT

This paper reports on a research study by the author that examined ten contemporary National Aeronautics and Space Administration (NASA) complex projects. In-depth interviews with the project managers of these projects provided qualitative data about the inner workings of the project and the methodologies used in establishing and managing the projects. The inclusion of a variety of space, aeronautics, and ground based projects from several different NASA research centers helped to reduce potential bias in the findings toward any one type of project, or technical discipline. The findings address the participants and their individual approaches. The discussion includes possible implications for project managers of other large, complex, projects.

INTRODUCTION

There is much written about how *important* the project manager is to a project [3,4,9]. Many authors also describe very specifically what they find as desirable characteristics in a project manager [1,5,7,12]. The typical set of these characteristics however, is often a mixed variety of traits, skills, and behaviors that taken together form a collage of items that are unlikely to be found in any one person. There is also little empirical evidence to support what is said to be desirable, compared with what the project manager actually brings to the table of project management. Much of what is available in the literature concentrates on *how-to-do* project management, or how project managers *should* manage. An entire industry and extensive library of information is available to provide the necessary tools and techniques for how-to-do and how-you-should-do project management [8,10,11]. Unfortunately, for both the profession of project management and the project manager him/herself, there is little available about what they have or need as a person that will help them in their role. The remaining question to be answered then is not what tools project managers *should use*, or what they *should do*, but one of what do they personally bring to project management and how do they use it in managing complex projects? The purpose of this paper is an attempt to partially answer this question by reporting on a research study that examined a sample of National Aeronautics and Space Administration (NASA) projects using in-depth interviews with the project managers.

METHODOLOGY

Ten contemporary NASA projects were chosen for the study to make up a stratified, opportunistic sample within a boundary definition of a complex project (Figure 1). To be a complex project the scope had to include the development of some unique science or technology, have a project cost greater than \$20 million, and have a completion time of from two to ten years in length. This definition helped to ensure that the selected projects were sufficiently large to require a depth and diversity of technological expertise such that a team was required to accomplish them. However, they were not so large that a project manager was likely to change during the project life cycle. All but one of the projects was in progress at the beginning of data collection. Choosing a variety of aeronautics, space, and ground based contemporary projects from several different NASA centers helped to reduce potential bias in the findings.

1. Bio-Research Satellite	6. Mars Rover
2. Space Bio-Research Experimental Hardware	7. Satellite Instrument I
3. Advanced Technology Aircraft Flight Test	8. Satellite Instrument II
4. Advanced Technology Flight Demonstration	9. Satellite Instrument III
5. Advanced Aerodynamics Wind Tunnel	10. Spacecraft Launch Vehicle

Figure 1. Study Projects

The research design employed a qualitative research framework following Eisenhardt [2]. Selection of a case-study strategy was based on the guidance of Yin [13] and each project treated as a separate case with the project manager as the primary source of information. Active, in-depth interviews [6] with each project manager used the researcher as both an instrument, and as a participant in the data collection. The interviews provided a rich source of data about the inner workings of each individual project manager's methodology for managing his/her project. Each interview lasted from one to three hours and was audiotape recorded. The participants reviewed a verbatim written transcript for correction and comment, and to provide additional information if needed.

FINDINGS

The research findings provide insight into the individual approaches used by the project manager participants. The evidence indicates that the managers of complex NASA projects are unique as individuals, but use similar approaches to how they establish and manage their projects.

Establishing the Project

How the project is established is important. Due to the nature of NASA projects, the driving constraint is often the need to meet a scheduled launch date. A recent paradigm shift to a faster-better-cheaper approach within NASA also identifies projects that exceed their approved budget profile by fifteen percent for review for cancellation. These two constraints greatly influence the project managers' approach to their role. Although the projects in the study were very complex,

project formulation was based on a few simple principles. The key issues for the project manager participants included early involvement in project formulation in order to 1) clearly define the project goal, 2) structure the project in ways comfortable to them, and 3) select the key members of the project team.

Early involvement provides the project manager with the visibility needed to determine the reality of the task s/he is facing before the project is completely defined and there is no hope of making adjustments. They are then able to begin their role with a clear understanding of the project requirements and can influence the technical parameters, cost, and schedule constraints of the project. With this understanding to work from, they clearly define the project goals so there is no ambiguity about what the project is to achieve. The science or technology to be delivered is always the main product. In formulating the project, they also identify specific success factors to meet the project goals. As stated by one project manager, this ensures that "when it flies, it works."

In establishing the project structure, the project manager takes maximum advantage of his/her strengths, and compensates for any personal weaknesses. In this way the project structure fits their personal style for the particular project and situation being faced. In the study projects the participants chose to focus on particular structures that they were comfortable with. One chose a structure that addressed the systems involved; "I organized it by systems in a unique way." Another used the more traditional work-breakdown-structure (WBS); "I broke it all the way down to the fourth level." One other used the budget; "I had a 300 element budget." And one focused on the project schedule; "I break it down fine enough so I can tell when something is going wrong." Whatever structure is chosen for the project, it is simple and fits the project manager's skill-set and intuitive sense of what is needed in the particular situation they face.

And finally, smaller teams are better. A few key team members are chosen that fit the project structure. This small team approach helps to ensure visibility and tight control, and that there are no extraneous roles. One project manager described this as, "It was a no-slack zone," meaning that everyone had a job and did it. Another project manager described it as, "I choose the best people I can find and delegate everything." Of the key members providing synergy with the project manager's strengths and weaknesses, none is more important than selecting a Deputy to handle areas where the project manager is weak, or does not care to be involved in. With the project goals defined, a structure in place, and the project team chosen, the project managers in the study next established how the project would be managed.

Managing the Project

NASA project managers establish clear roles and have few rules. Beyond formulating the project in beneficial ways, they created a framework for day-to-day operations in the project by establishing clear roles and only a few operating rules within the project structure. By providing clear role definition there is no duplication of effort or responsibility. Everyone knows their role and that of the project manager. The project manager is not the technical expert on the project, but there is no question about who is in charge. The specialist team members are both responsible and held

accountable for technical issues. All work is directed toward the project goal, and progress toward the goal is measured using the success factors identified during formulation of the project.

By having just a few rules there is no ambiguity about how the project will operate. The methods for communicating are kept simple and in real-time. Outside of technical issues, the project manager handles all external contact for the project. Periodic meetings, video and telephone conferencing, and email are all used in communicating, but issues that may affect project outcome never wait; the key players involved in an issue meet ad hoc to address them. One project manager never used meetings to discuss status of the project, only to address issues affecting progress. Through a process of thin but constant oversight, she knew when something was going wrong. Problem finding and solving was situational and adapted by the project manager to fit the project environment.

In a complex project there are often multiple indications that a problem exists. One of the flight test projects in the study with an extremely tight schedule for project completion used what the project manager described as a "shotgun approach" for problem finding and solving. "Shotgunning" consisted of the key team members sitting in a circle and describing what they saw as the problem from their point of view. Once there was a consensus of what the problem was, the same process was used to explore potential solutions. The unique implementation step of this process however, did not seek only the most probable solution; implementation attacked all high-potential solutions simultaneously. Using this approach the team probably spent some time and money testing or replacing perfectly good equipment, but as an overall methodology they saved many times that amount. The daily costs being incurred by the project for the availability of the flight test range and the tracking aircraft and crew, plus the rest of the "marching army" participating in the test, were all minimized by getting back into the air as quickly as possible and completing the test.

The rules for making decisions in a project are kept simple, and focus on consensus. Although reaching consensus is the goal, everyone understands that the project manager will make a decision if the team cannot reach consensus within a prudent amount of time. In addition, the project manager approves or makes technical decisions that affect cost, schedule, or risk to the project outcome.

SUMMARY

The research described here provides qualitative data about the methodologies used by managers of complex NASA projects. There is a remarkable consistency in how each participant went about the job of managing his/her project. The evidence gathered shows the positive impact of early involvement by the project manager in influencing the project requirements, in establishing goals and success factors, and in controlling cost and schedule constraints to ensure they can be met. In creating the project structure, the project manager uses personal strengths and compensates for weaknesses in ways that are compatible, and comfortable for them. The choice of a small project team fits the project structure they define, and they establish clear, unambiguous roles for the key team members. There is no question about who on the team is responsible for what, or who is in charge of the project. They also have only a few operating rules that prescribe how the team will communicate, find and solve problems, and make decisions. The data also indicates that the project

manager participants appear to be unique individuals compared with others in the larger engineering population.

IMPLICATIONS

The use of a small sample of complex NASA projects as microcosms for exploratory development of management theory helped to bound the research to manageable proportions. At the same time however, this bounding limits the ability to directly draw conclusions outside of these microcosms. For NASA the implications are to continue to expand the involvement of project managers early in the development of projects to help foster the use of the methodologies described here. Due to the similarity of complex projects in other areas of industry such as aerospace [8], it seems reasonable to expect that these research findings may also be applicable to project managers of other large, complex projects outside of NASA. Future research in other areas would test the validity of the findings presented here across a range project domains.

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